DoD Software Engineering and System Assurance
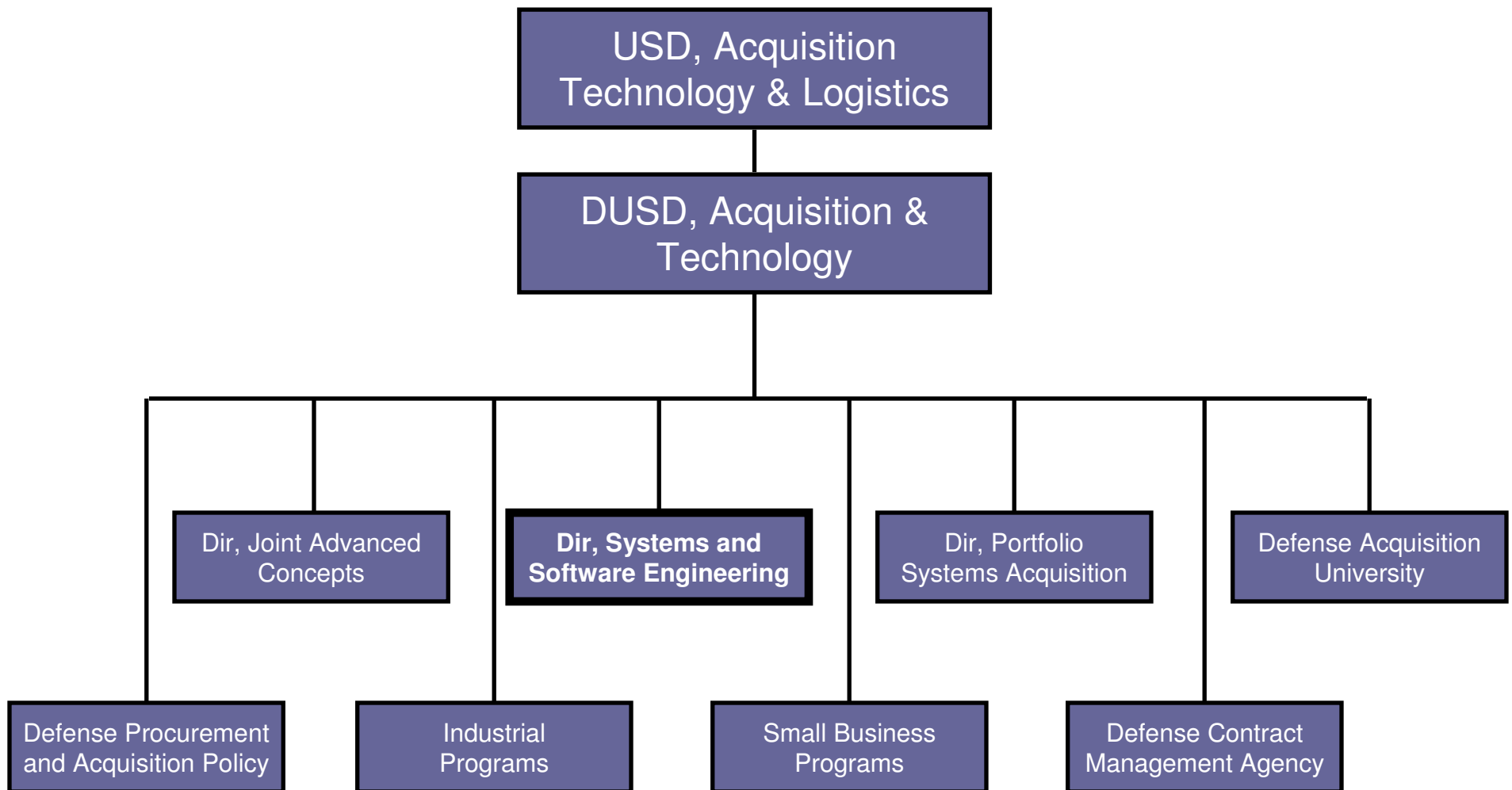
New Organization – New Vision

Kristen Baldwin

Deputy Director, Software Engineering and System Assurance

Office of the Under Secretary of Defense

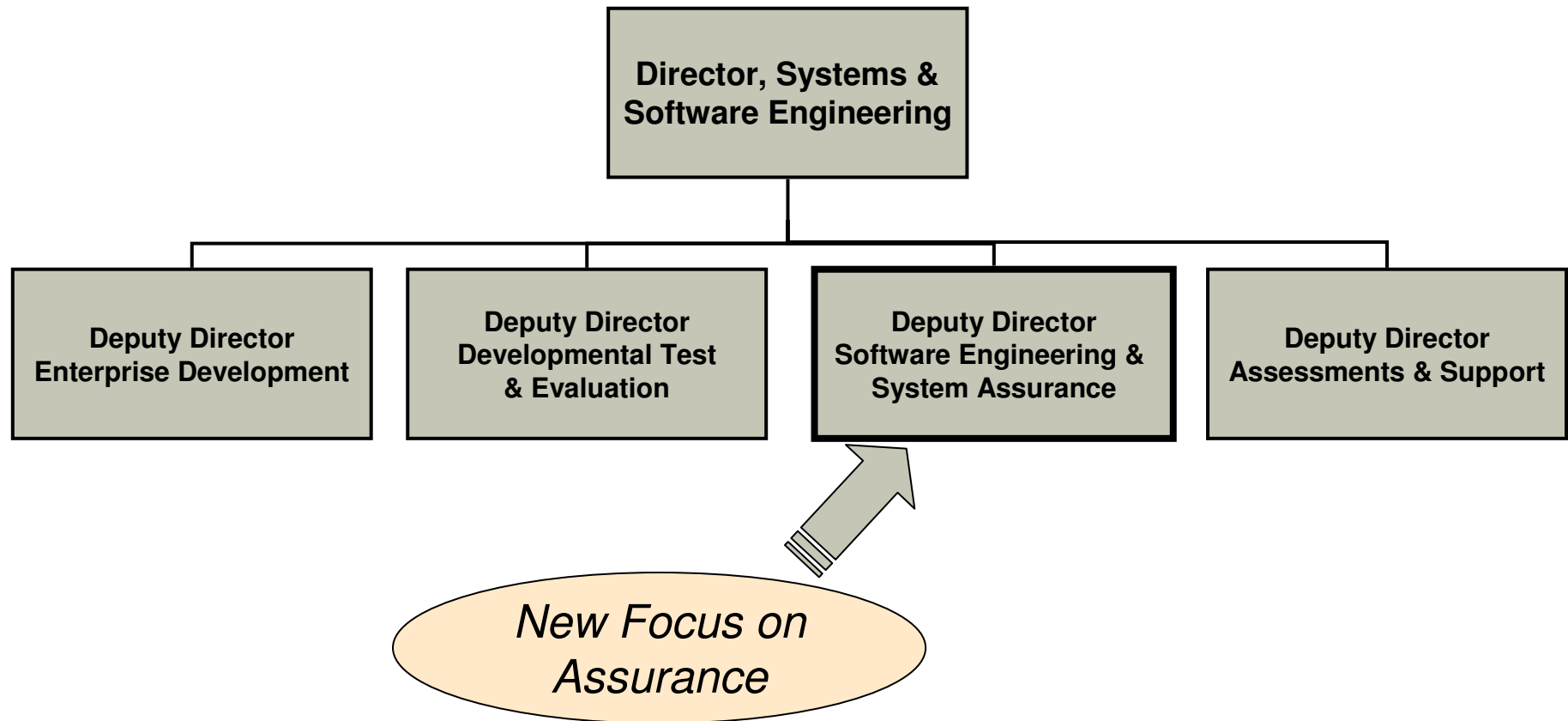**Acquisition, Technology and Logistics**

OUSD (AT&L) Organization
May 2006

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| Dir, Joint Advanced Concepts | **Dir, Systems and Software Engineering** | Dir, Portfolio Systems Acquisition | Defense Acquisition University |

| Defense Procurement and Acquisition Policy | Industrial Programs | Small Business Programs | Defense Contract Management Agency |

Systems and Software Engineering

An Organizational Construct

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│  Enterprise │ │ Developmental│ │  Software   │ │ Assessments │
│ Development │ │  Test &     │ │ Engineering │ │ & Support   │
│             │ │ Evaluation  │ │ & System    │ │             │
│             │ │             │ │ Assurance   │ │             │
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New Focus on Assurance

Acquisition program excellence through sound systems and software engineering

Establishing a DoD Engineering Center of Excellence
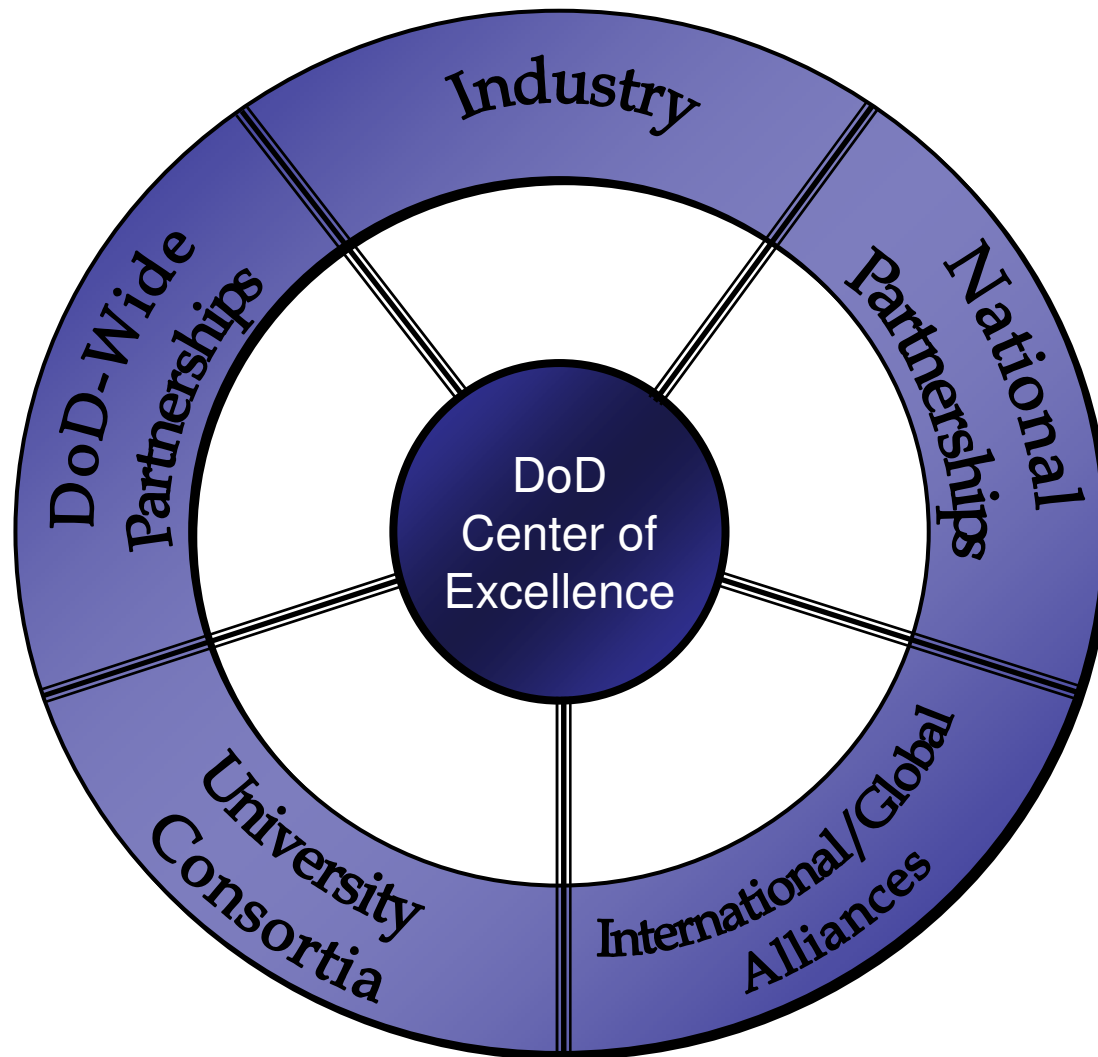
DoD Engineering Center of Excellence

- Support Acquisition Success
- Improve State-of-the-Practice of Engineering
- Leadership, Outreach and Advocacy
- Foster Resources to Meet DoD Needs

The wheel diagram contains:
- DoD Center of Excellence (center)
- Industry
- National Partnerships
- International/Global Alliances
- University Consortia
- DoD-Wide Partnerships

Elements of a DoD Strategy for Software

- Support Acquisition Success

  - Ensure effective and efficient software solutions across the acquisition spectrum of systems, SoS and capability portfolios

- Improve the State-of-the-Practice of Software Engineering

  - Advocate and lead software initiatives to improve the state-of-the-practices through transition of tools, techniques, etc.

- Leadership, Outreach and Advocacy

  - Implement at Department and National levels, a strategic plan for meeting Defense software requirements

- Foster Software Resources to meet DoD needs

  - Enable the US and global capability to meet Department software needs, in an assured and responsive manner

Promote World-Class Leadership for Defense Software Engineering

Getting Started – What are we Doing?

- Identifing software issues, needs
  – Software Industrial Base Study
  – NDIA Top Software Issues Workshop
  – Defense Software Strategy Summit

- Creating opportunities, partnerships
  – Established network of Government software POCs
  – Chartered the NDIA Software Committee and Expert Panel
  – Information exchanges with Government, Academia, and Industry

- Executing focused initiatives
  – Providing software support to acquisition programs
  – Foundational assessment of software policy/guidance
  – Study of Software/SE integration
  – Software Engineering reference curriculum
  – Engineering for System Assurance
  – SoS Systems Engineering Guide
  – CMMI Integrity, CMMI-ACQ, CMMI Guidebook

Top Software Issues*

1. The impact of requirements upon software is not consistently quantified and managed in development or sustainment.

2. Fundamental system engineering decisions are made without full participation of software engineering.

3. Software life-cycle planning and management by acquirers and suppliers is ineffective.

4. The quantity and quality of software engineering expertise is insufficient to meet the demands of government and the defense industry.

5. Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems.

6. There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments.

7. Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk.

*NDIA Top Software Issues Workshop
August 2006

DoD Software -- What We're Seeing*

- Software systemic issues are significant contributors to poor program execution

  - Software requirements not well defined, traceable, testable

  - Immature architectures, COTS integration, interoperability, obsolescence (electronics/hardware refresh)

  - Software development processes not institutionalized, planning documents missing or incomplete, reuse strategies inconsistent

  - Software test/evaluation lacking rigor and breadth

  - Schedule realism (compressed, overlapping)

  - Lessons learned not incorporated into successive builds

  - Software risks/metrics not well defined, managed

*Based on ~65 program reviews to date

SW Issue/GAP Workshop Findings

Primary Software Focus Groups*

Software Acquisition Management

Standards – O, N
DAG Ch 4/7 – O, AF
Prog Spt – O, All
Contract Language – A, M, N
SW Estimation – GAP
Lifecycle Policy – AF
Risk Identification - GAP

Software Development Techniques

Agile – O, SEI
Architecture – A, SEI
COTS – SEI
Open Source – AF
Sustainment – GAP
SW Interoperability – GAP
SW Test - GAP

SW & SE Integration

Requirements – GAP
SE/SW Process Int – O
SW Council – N
SW Dev Plan – N
SW in SEP – N
SW in Tech Reviews – N
SW Quality Attributes - GAP

Knowledge Sharing

Standards – O, N
DAG Ch 4/7 – O, AF
Prog Spt – O, All
Contract Language – A, M, N
Estimation – GAP
Lifecycle Policy – AF
Risk Identification - GAP

Data and Metrics

SW Metrics – A, O
SW Cost – O
SW EVM – DCMA
SW Estimation - GAP

Human Capital

Education Sources – N, A
Leadership Training – A, SEI
SETA Quals – GAP
SW Human Cap Strategy – GAP
Industrial Base – O
University Curriculum – O
Worforce Survey - AF

Ongoing
__Initiative Owners__
O – OSD/SSA
A – Army
N – Navy
AF – Air Force
M – MDA
SEI
DCMA
GAP – No activity

Ongoing SW Initiatives (w/owners) and Gaps binned to Focus Groups

SYS

Next Steps

Near Term:

- Determine metrics for each of the 6 Focus Areas
  - Based upon source reports (ie. SW Summit, Top Issues, PSRs, Historical SW Studies)
- Coordinate ongoing initiatives (via Working Group Participation, Defense Software in Acquisition Collaborators)
  - Support and/or leverage initiatives where appropriate
  - Provide visibility across the Department
- Determine action plans for each gap considering:
  - Priority
  - Near Term/Long Term impacts
  - NDIA SW Committee, others, interest in accepting gap(s)
- Engage other communities and participants
  - IT, Business, Research

Over Time:

- Reassess ongoing initiatives against focus area metrics
  - Determine new gaps, or additional effort required to address core issues
- Reassess focus area metrics against systemic software issues
  - From future SW Summits, Systemic Analysis, etc…

Software In Acquisition Workshop
October 16-17, 2007

- Purpose: Off-year workshop (Summit held every 2yrs)
  - Measure progress on initiatives against known issues
  - Collaborate on gaps
  - Identify emerging issues, or adjust measures for existing ones
- Format:
  - Leadership updates
  - Panel on hot topics (perhaps embedded vs IT software*)
  - Presentations to share progress, experiences
  - General discussion/summary for each focus group
- Audience: DoD programs, practitioners, industry, FFRDC, developers/integrators, academia
  - Community forum focused on software in acquisition
- Location: Washington, DC area, TBD

*based upon ideas generated at SSTC

OUSD(AT&L)/SSA FOCUSED INITIATIVES

Opportunities for Collaboration!

System Assurance Context for the PM
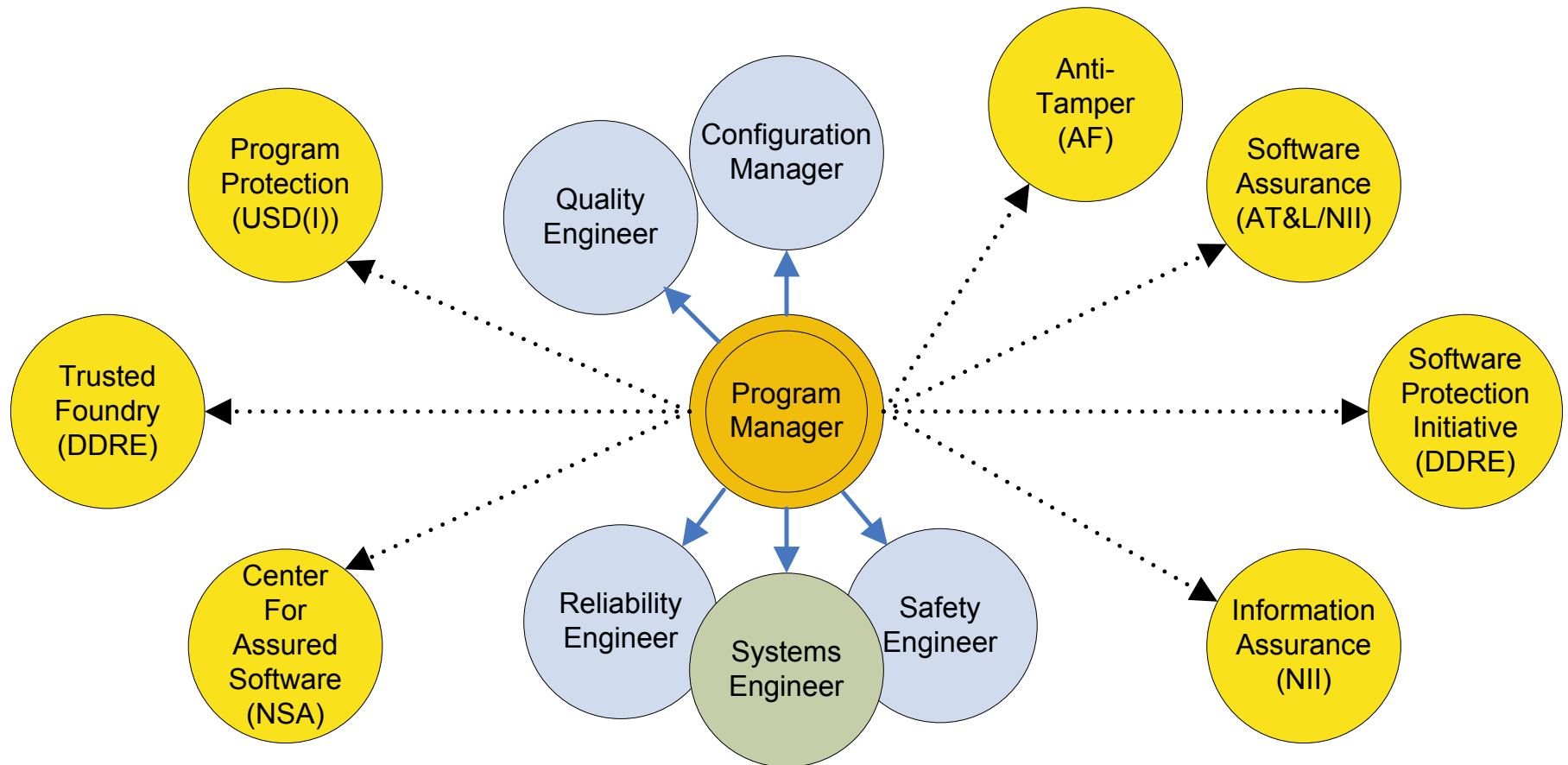
System Assurance Definition
Level of confidence that a system functions as intended, is free of exploitable vulnerabilities, and protects critical program information

Path Forward

- Create a 'framework' to integrate multiple security disciplines and policies
  - Leverage 5200.39: expand CPI definition to include system assurance and total life cycle
- Use the Program Protection Plan (PPP) to identify CPI and address assurance for the program
  - Link plans (e.g., Anti-Tamper, Software Protection, System Engineering, Assurance Case)
- Modify Acquisition and System Engineering guidance to integrate system assurance across the lifecycle
  - Milestone Decision Authority visibility
  - Guidebook on Engineering for Assurance for program managers/engineers

Raise the bar:	
Awareness	- Knowledge of the supply chain - Who has access to our critical assets
Protection	- Protect critical assets through security practices - Engineer our systems for assurance

System Assurance Guidebook
Project Description

Issue: Systems are vulnerable to malicious tampering

- Project Description:
  - Provide *practical guidance* on augmenting systems engineering practice for system assurance
  - Synthesize existing knowledge from organizations, standards and best practices
  - Recap concepts from standards
- Opportunity for:
  - Practitioners, academe who implement systems engineering, assurance, safety, security, program protection, etc. into processes and programs
- The project addresses
  - Integration of assurance guidance and practices into systems engineering
- Product:
  - Guidebook on Engineering for System Assurance
- Outcome Goal:
  - Intent is to yield assured program / system with demonstrable evidence of assurance

System of Systems
Project Description

Issue: No common definition, or guidance for SoS

- Project Description:
  - Effort led by the Office of the Secretary of Defense
  - Collaborative Approach with DoD, Industry, Academia
- Purpose
  - 6 month effort addressing areas of agreement across the community
  - Focus on technical aspects of SE applicable across SoS management constructs
  - Vehicle to capture and debate current SoS experience
- Audience
  - Program Managers and Lead/Chief Engineers
- The project addresses
  - Considerations for engineering above a system level
- Product:
  - SoS Engineering Guide, v1.0, Fall 2007
- Outcome Goal:
 - Program managers/chief engineers have requisite knowledge to manage SoS

System of Systems

- ## Why SoS
  - Changing operations - changing threats and concepts mean that new (ad hoc) SoS configurations will be needed to address changing, unpredictable operational demands
  - Legacy - given defense budget projections, current systems will be part of the defense inventory for the long-term and need to be factored into any approach to SoS

- ## Observations/challenges
  - Scale - size of defense enterprise makes a single integrated architecture infeasible
  - Ownership/Management - individual systems are owned by the military component or agencies, introducing constraints on management and SE
  - Criticality of software - SoS typically focus on integration across systems through cooperative or distributed software
  - Role of network - conceptually DoD SoS will be network-based; budgetary and legacy challenges could lead to uneven implementation
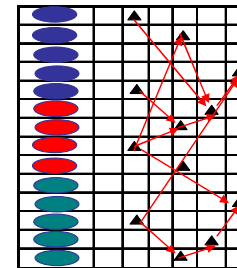
System of Systems
The Management Challenge
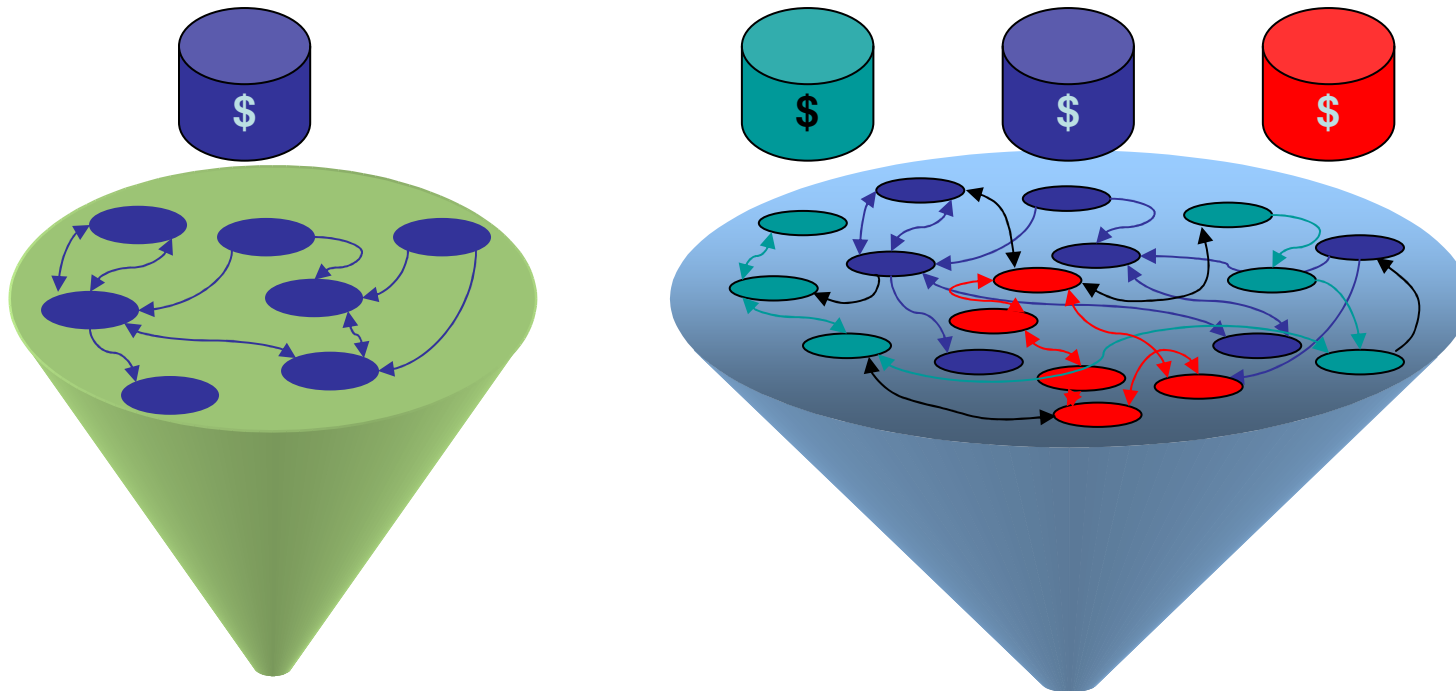
SoS:
Within
Single
Organization
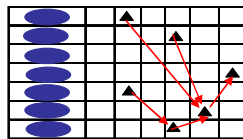
Joint SoS:
Interdependencies
Across
Multiple
Organizations

Political and Cost Considerations impact on Technical Issues

STEVENS
Institute of Technology

Issue: There is no commonly accepted structure or content for graduate software engineering education

- Project Description:
  - Develop a core curriculum and core competencies for software engineering
- Opportunity:
  - Industrial and government workforce customers of SWE graduate education
  - Academics who provide SWE <u>and SE</u> graduate education
  - Professional societies with a vested interest in SWE <u>and SE</u> graduate education
- The project addresses
  - Inconsistencies in software graduate degrees
  - Poor definition of labor categories and software expertise
  - The divide between systems and software engineers in industry, government, and academia
  - The project will integrate SE principles and practices into a SWE curriculum.
- Product:
  - An approved curric that can be adopted by the community (industry, academia, associations)
- Outcome Goal(s):
  - Software engineers have a more consistent training base

SE/SW Process Integration Project Description

Issue: SE and SW have not been well integrated on projects

- Project Description:
  - Study SE and SW processes, capture ongoing harmonization efforts
  - Assess current guidance
  - Identify opportunities for better integration
- Opportunity for:
  - SE and SW process owners or practitioners
  - Academe who teach/study SE and SW
- The project addresses
  - Integration of SW with requirements, risk management and other SE technical and management processes
- Product:
  - Report and recommendations for SW policy, guidance, and tools to better integrate with SE and Acquisition
- Outcome Goal:
  - Software is a major factor in engineering design and acquisition management decisions

CMMI-Acquisition
Project Description

Issue: Acquirers lack an appraisable model for acquisition PI

- Project Description:
  - Using GM CMMI for Outsourcing; pilot and generate CMMI-ACQ
  - Involve broad set of acquisition stakeholders to ensure wide application
- Opportunity for:
  - Process improvement stakeholders
  - Acquiring organizations
- The project addresses
  - Identification of key acquirer activities and products
  - Amplification of CMMI core practices to capture acquirer considerations
- Product:
  - CMMI model for Acquisition (built on CMMI foundation for consistency with CMMI-DEV)
- Outcome Goal:
  - Acquisition organizations implement best practices, and institute organizational process improvement

Additional areas for collaboration...and attention

- ## Additional projects
  - Software earned value guidance
  - Software metrics
  - Software knowledge portal

- ## Some key gaps remaining
  - Software sustainment
  - Software test
  - Software estimation
  - Software risk identification

Our Challenge

- Given the shortage of software resources and critical software reliance
  - We cannot afford to be stovepiped
  - We must integrate across cross-functional perspectives to improve our software capability

- We must focus on long standing software issues
  - Leverage ongoing activities to make a difference
  - Invest in collaborative efforts where there are gaps

- Now…
  - Work together to address software issues
  - Submit papers for the October Conference
  - Join the DoD SIA Collaborators
  - Contribute to ongoing initiatives: SW Curriculum, SoS, Sys Assurance, CMMI Guides, more
  - Contact us at ATL-SSA@osd.mil

Become a DoD Center of Excellence